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Indian Standard

SPECIFICATION AND CHARACTERIZATION METHODS FOR NONWOVEN 'E' GLASS MAT

ICS 31.180

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2002 **Price Group 5**

Printed Circuits Sectional Committee, LTD 17

NATIONAL FOREWORD

This Indian Standard which is identical with IEC/PAS 62212 (2001) 'Specification and characterization methods for nonwoven "E" glass mat' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Printed Circuits Sectional Committee and approval of the Electronics and Telecommunication Division Council.

The text of the IEC/PAS document has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standards and has decided that these are acceptable for use in conjunction with this standard:

IPC-T-50	Terms and definitions for interconnecting and packaging electronic circuits
IPC-PC-90	General requirements for implementation of statistical process control
T 251 wd-96	Air permeability of porous papers, fabrics, and pulp
T 411 om-89	Thickness (caliper) of paper, paperboard and combined board
T 456 om-87	Wet tensile breaking strength of paper and paperboard
T 1007 om-92	Sample location
T 1008 om-92	Test conditions for fiberglass mat test methods
T 1009 om-92	Tensile strength and elongation at break
T 1011 om-92	Basis weight of fiberglass mats
T 1013 om-92	Loss of ignition of fiberglass mats

Indian Standard

SPECIFICATION AND CHARACTERIZATION METHODS FOR NONWOVEN ‘E’ GLASS MAT

1 METHODOLOGY

1.1 Scope This specification covers mat made from nonwoven “E” glass fibers intended as a reinforcing material in laminated plastics for electrical and electronic use.

1.2 Purpose This specification determines the nomenclature, definitions, general comments, and physical requirements for mat made from nonwoven “E” glass.

1.3 Classification This specification provides physical characteristics of the mat required to meet the design and performance requirements of the PWBs.

2 APPLICABLE DOCUMENTS

2.1 IPC[1]

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-PC-90 General Requirements for Implementation of Statistical Process Control

2.2 TAPPI[2]

T 251 wd[3]-96	Air Permeability of Porous Papers, Fabrics, and Pulp
T 411 om-89	Thickness (Caliper) of Paper, Paperboard, and Combined Board
T 456 om-87	Wet Tensile Breaking Strength of Paper and Paperboard
T 1007 om-92	Sample Location
T 1008 om-92	Test Conditions for Fiberglass Mat Test Methods
T 1009 om-92	Tensile Strength and Elongation at Break
T 1011 om-92	Basis Weight of Fiberglass Mats
T 1013 om-92	Loss of Ignition of Fiberglass Mats

3 REQUIREMENTS

3.1 Terms and Definitions The definitions and terms shall be in accordance with IPC-T-50, TAPPI documents, and those stated in 3.1.1 through 3.1.13.

3.1.1 Bagginess Material that is distorted, stretched, or deformed in the middle or along the edges.

3.1.2 Binder A thermoset or thermoplastic resin used to hold the glass fibers together and provide mechanical strength to the nonwoven mat.

3.1.3 Bundles Undispersed fiber bundles.

3.1.4 Caliper Variation Sheet is of uneven thickness in the width and length, exceeding the product’s specification.

3.1.5 Conducting Particles Small foreign particles capable of conducting current.

3.1.6 Dents Indentations in the surface of the mat or in the edge of the roll.

3.1.7 Dirt Small dark particles of foreign origin (i.e., floor dirt or other visible contaminates).

3.1.8 Edge Tear/Damaged Roll Edge Tears and/or damage to the edge of the mat.

3.1.9 Holes/Thin Spots An area in the mat where few or no fibers are present.

3.1.10 Poor Formation Very uneven distribution of fibers in the mat resulting in a rough surface or appearance.

3.1.11 Soft Roll/Telescoping Roll that has been loosely wound, resulting in an uneven side-to-side hardness and/or evenness.

3.1.12 Weight Variation Basis weight variation in the width and length exceeding the product’s specification.

3.1.13 Wrinkles/Folds A permanent fold, crease, or ridge in the mat, generally in the machine direction, occurring during processing or rewinding.

3.2 Physical Requirements

3.2.1 Product Typical physical requirements of nonwoven “E” glass mats are provided at the end of this specification in the form of specification sheets. The specification sheets may not cover all of the commercially available nonwoven glass used in base material manufacturing. This specification is not designed to preclude their use in these applications, provided the requirements of Section 3 are met. New specification sheets **shall** be added as materials and data are made available.

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[1] IPC, 2215 Sanders Road, Northbrook, IL 60062, 847-509-9700, http://www.ipc.org

[2] TAPPI, 1-800-322-8686 (U.S.), 1-800-446-9431 (Canada), +1-770-209-7303 (International), or visit http://www.tappi.org for a list of local TAPPI divisions.

[3] Withdrawn Method – Available upon request from TAPPI.

3.2.2 "E" Glass Fibers "E" glass fibers **shall** have a chemical composition by weight within the limits of Table 3-1.

Table 3-1 Chemical Compositions

Composition	Range
Silicon dioxide	52-56%
Aluminum oxide	12-16%
Boron oxide	5-10%
Sodium oxide and potassium oxide	0-2%
Magnesium oxide.	0-5%
Calcium oxide	0-0.8%
Titanium dioxide	0-1.5%
Iron oxide	0.5-0.4%
Iron	0-1%

3.2.3 Diameter and Range The nominal filament diameter and the range of filament diameter averages in µm are as shown in Table 3-2.

Table 3-2 Diameter and Range

Code	Diameter (µm)	Range (µm)
D	5	4.83 - 5.83
DE	6	5.84 - 6.85
E	7	6.35 - 7.61
G	9	8.89 - 10.15
H	11	10.16 - 11.42
K	13	12.7 - 14.0

3.3 Visual Requirements

3.3.1 Visual/Appearance Procedures Mats **shall** be inspected across the full width of the sheet. The mat **shall** be of uniform appearance and formation. The lighting source should be mounted behind the viewing surface of the mat so as to illuminate the mat from the back with perpendicular light.

3.3.2 Visual/Appearance Defects Count all defects except where two or more defects represent a single local condition (all within one linear meter). In this case, count only the more serious defect as one defect. A continuous defect is counted as one defect for each linear meter or fraction thereof in which it appears. Classify the defects as listed in Table 3-3. Table 3-4 lists the test methods and procedures used to determine values found in the applicable specification sheets.

Table 3-3 Defect Classifications

Defect	Major	Minor
Bagginess		•
Weight Variation	•	
Caliper Variation	•	
Conducting Particles	•	
Edge Tears	•	
Dents		•
Dirt	•	
Wrinkles/Folds	•	
Holes	•	
Poor Formation	•	
Bundles		•
Soft Roll/ Telescoping		•

Table 3-4 TAPPI Test Methods and Procedures

Test Method	Procedure Number
Sample Location	T 1007
Test Conditions	T 1008
Basis Weight	T 1011
Tensile Strength	T 1009
Solvent Tensile	T 456[4]
Caliper	T 411
Loss on Ignition (LOI)	T 1013
Porosity	T 251
Wet-Out[5]	

3.4 Dimensional Requirements

3.4.1 Roll Length The roll length **shall** be measured by the clock method or equivalent. In the clock method, the measuring device consists of a wheel or pair of wheels mounted on a free-running axle, connected to a counting mechanism graduated to read in meters. The surface of the wheels is to be covered with a friction material to prevent slippage. The circumference of the wheel is to be known and synchronized with a mechanism to read in meters.

The measuring device is to be mounted in such a way that movement of the mat through the machine will turn the wheels. The roll will be measured from beginning to end and the length reported to the nearest meter.

3.4.2 Roll Width Place the roll of mat in the horizontal position. Measure the width to within 3.2 mm perpendicular to the edges using steel tape.

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[4] Substitute solvent for water saturation. Type of solvent should be agreed upon between user and supplier.

[5] It is recommended that the user request samples of the nonwoven mat from the supplier to evaluate wet-out characteristics and to ensure compatibility with current process and resin systems.

4 QUALITY ASSURANCE

4.1 Responsibility for Inspection Unless otherwise specified in the purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the purchase order, the supplier may use their own or any other facility suitable for the performance of the inspection requirements herein, unless disapproved by the procuring authority. The procuring authority reserves the right to perform any of the inspections set forth in the specification, where such inspections are deemed necessary, to assure supplies and service is performed to the prescribed requirements.

4.1.1 Test Equipment and Inspection Facilities Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection **shall** be established and maintained by the supplier. The supplier **shall** perform the establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment.

4.1.2 Standard Laboratory Conditions Unless otherwise specified herein, all inspections **shall** be performed in accordance with standard TAPPI procedures (see Table 3-4). If a referee method is required, it **shall** be agreed upon between user and supplier.

4.2 Preparation of Samples Unless otherwise specified herein, samples **shall** be prepared in accordance with standard TAPPI procedures (see Table 3-4). If a referee method is required, it **shall** be as agreed upon between user and supplier.

4.3 Inspection Procedure All reels **shall** be inspected per 4.3.1. Visual defects are classified in Table 3-3.

4.3.1 Classification of Major and Minor Visual Defects

4.3.1.1 Major Defect A major defect is a defect that is likely to result in failure, or to materially reduce the usability of the unit of product for its intended purpose (see Table 3-3).

4.3.1.2 Minor Defect A minor defect is a defect that is not likely to materially reduce the usability of the unit of product for its intended purpose (see Table 3-3).

4.3.2 Sampling Plans Sampling plans sufficient to ensure an acceptable quality **shall** be used (see Table 4-1).

Table 4-1 General Inspection

Number of Rolls Shipped	Minimum Number of Rolls Inspected
2-8	2
9-15	4
16-25	6
26-50	16
51-91	23
91-150	38

4.4 Acceptability Quality Level No one meter will be penalized with more than one major defect. A continuous defect **shall** be counted as one defect for each meter or fraction thereof in which it occurs. Latent defects or defects that appear during and after treating can occur to make the product unacceptable for its intended use. The acceptable level of these defects and the resolution of any rejects arising must be negotiated between user and supplier.

4.5 Statistical Process Control (SPC) SPC utilizes systematic statistical techniques to analyze a process or its outputs. The purpose of these analyses is to take appropriate actions to achieve and maintain a state of statistical control, and to assess and improve process capability. The primary goal of SPC is to continually reduce variation in processes, products, or services in order to provide product meeting or exceeding real or important customer requirements.

Implementation of SPC **shall** be in accordance with IPC-PC-90.

Depending on the progress made in implementing SPC on a particular product, an individual supplier may demonstrate compliance to specification with any of the following:

- Quality conformance evaluations
- End-product control
- In-process product control
- Process parameter control

5 PREPARATION FOR DELIVERY

5.1 Roll Size The outside diameter, width, and core size **shall** conform to the customer's specification.

5.1.1 Roll Length Roll length **shall** be determined in accordance with 3.4.1 and **shall** be as specified on the purchase order (min-max roll length). Roll diameter may be substituted for roll length as a means of specifying roll size.

5.1.2 Roll Width Roll width **shall** be determined in accordance with 3.4.2 and **shall** be as specified on the purchase order. The width of the mat **shall** be within -0 mm + 6.4 mm of the value specified.

5.2 Splices There **shall** be a maximum of one splice per roll, or as otherwise agreed upon between user and supplier or specified per purchase order. All splices **shall** be flagged and compatible with resin solvents. Splices **shall** not lose strength and **shall** withstand treater stresses.

5.3 Preservation and Packaging Preservation and packaging **shall** be in such a manner as to ensure delivery in a condition that will pass the requirements of this specification.

5.4 Packing Packing **shall** be as specified.

5.5 Labeling In addition to any special labeling required by the contract or order, each roll **shall** be labeled clearly to assure product identity.

6 NOTES

6.1 Ordering Data The purchase order should specify the following:

(a) Product grade code designation
(b) Basis weight required
(c) Roll size: outside diameter, width, and length
(d) Core inside diameter size (i.e., 76.2 mm or 152.4 mm I.D.)
(e) Customer purchase order number
(f) Special labeling instructions
(g) Special packing instructions
(h) Ship-to address
(i) Purchaser's part number, if required
(j) Quantity: total weight and/or length

Specification Sheets for Nonwoven "E" Glass Mat

Specification Sheet #	Description
01	Glass Mat Epoxy 9.0 µm x 6.5 mm
02	Glass Mat Epoxy 11.0 µm x 6.5 mm
03	Glass Mat Epoxy 7.5 µm x 6.5 mm
04	Glass Mat Polyvinyl Alcohol 6.5 µm x 6.5 mm
05	Glass Mat Polyvinyl Alcohol 6.5 µm x 6.5 mm

Specification Sheet		
Specification Sheet	:	IPC-4130/01
# Reinforcement	:	Glass Mat
Binder Identification	:	Epoxy
Fiber Identification	:	9.0 µm x 6.5 mm

Nonwoven "E" Glass Mat Requirements

Requirement	Specification	Units	Test Method	Ref. Para
1. Basis Weight	–	g/m^2	T 1011	4.1.2 3.1.12
nominal	80.0			
minimum	76.0			
maximum	84.0			
2. Caliper	–	mm	T 411	4.1.2 3.1.4
nominal	41			
minimum	37			
maximum	45			
3. LOI	–	%	T 1013	4.1.2
nominal	10.0			
minimum	8.0			
maximum	12.0			
4. Tensile	–	kg/15 mm	T 1009	4.1.2
MD	≥5.9			
CD	≥2.9			
5. Solvent Tensile	–	kg/15 mm	T 456*	4.1.2
MD	≥4.7			
6. Porosity	–	cm^3/sec/cm^2 @12.7 mm pressure drop	T 251	4.1.2
nominal	241			
minimum	216			
maximum	267			

Specifications should be changed to suit buyer's needs.

Specification Sheet

Specification Sheet	:	IPC-4130/02
# Reinforcement	:	Glass Mat
Binder Identification	:	Epoxy
Fiber Identification	:	11.0 µm x 6.5 mm

Nonwoven “E” Glass Mat Requirements

Requirement	Specification	Units	Test Method	Ref. Para
1. Basis Weight	–	g/m^2	T 1011	4.1.2 3.1.12
nominal	100.0			
minimum	95.0			
maximum	105.0			
2. Caliper	–	mm	T 411	4.1.2 3.1.4
nominal	.51			
minimum	.46			
maximum	.56			
3. LOI	–	%	T 1013	4.1.2
nominal	10.0			
minimum	8.0			
maximum	12.0			
4. Tensile	–	kg/15 mm	T 1009	4.1.2
MD	≥7.1			
CD	≥3.5			
5. Solvent Tensile	–	kg/15 mm	T 456*	4.1.2
MD	≥5.7			
6. Porosity	–	cm^3/sec/cm^2 @12.7 mm pressure drop	T 251	4.1.2
nominal	267			
minimum	241			
maximum	292			

Specifications should be changed to suit buyer’s needs.

Specification Sheet
Specification Sheet : IPC-4130/03
# Reinforcement : Glass Mat
Binder Identification : Epoxy
Fiber Identification : 7.5 µm x 6.5 mm

Nonwoven "E" Glass Mat Requirements

Requirement	Specification	Units	Test Method	Ref. Para
1. Basis Weight	–	g/m^2	T 1011	4.1.2
nominal	105.0			3.1.12
minimum	100.0			
maximum	105.0			
2. Caliper	–	mm	T 411	4.1.2
nominal	.56			3.1.4
minimum	.50			
maximum	.62			
3. LOI	–	%	T 1013	4.1.2
nominal	10.0			
minimum	8.0			
maximum	12.0			
4. Tensile	–	kg/15 mm	T 1009	4.1.2
MD	≥6.5			
CD	≥3.2			
5. Solvent Tensile	–	kg/15 mm	T 456*	4.1.2
MD	≥5.2			
6. Porosity	–	$cm^3/sec/cm^2$ @12.7 mm pressure drop	T 251	4.1.2
nominal	127			
minimum	102			
maximum	152			

Specifications should be changed to suit buyer's needs.

Specification Sheet

Specification Sheet	:	IPC-4130/04
# Reinforcement	:	Glass Mat
Binder Identification	:	Polyvinyl Alcohol
Fiber Identification	:	6.5 µm x 6.5 mm

Nonwoven "E" Glass Mat Requirements

Requirement	Specification	Units	Test Method	Ref. Para
1. Basis Weight nominal minimum maximum	– 105.0 100.0 105.0	g/m^2	T 1011	4.1.2 3.1.12
2. Caliper nominal minimum maximum	– .56 .50 .62	mm	T 411	4.1.2 3.1.4
3. LOI nominal minimum maximum	– 7.0 5.0 9.0	%	T 1013	4.1.2
4. Tensile MD CD	– ≥5.3 ≥2.7	kg/15 mm	T 1009	4.1.2
5. Solvent Tensile MD	– ≥4.2	kg/15 mm	T 456*	4.1.2
6. Porosity nominal minimum maximum	– 124 102 152	cm^3/sec/cm^2 @12.7 mm pressure drop	T 251	4.1.2

Specifications should be changed to suit buyer's needs.

Specification Sheet

Specification Sheet	:	IPC-4130/05
# Reinforcement	:	Glass Mat
Binder Identification	:	Polyvinyl Alcohol
Fiber Identification	:	6.5 µm x 6.5 mm

Nonwoven "E" Glass Mat Requirements

Requirement	Specification	Units	Test Method	Ref. Para
1. Basis Weight nominal minimum maximum	– 75.0 71.3 78.8	g/m^2	T 1011	4.1.2 3.1.12
2. Caliper nominal minimum maximum	– 38 34 42	mm	T 411	4.1.2 3.1.4
3. LOI nominal minimum maximum	– 7.0 5.0 9.0	%	T 1013	4.1.2
4. Tensile MD CD	– ≥3.5 ≥1.8	kg/15 mm	T 1009	4.1.2
5. Solvent Tensile MD	– ≥2.8	kg/15 mm	T456*	4.1.2
6. Porosity nominal minimum maximum	– 178 152 203	cm^3/sec/cm^2 @12.7 mm pressure drop	T 251	4.1.2

Specifications should be changed to suit buyer's needs.

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